only variable of this class which has been observed for a long period, and the observations in this case only extend over three hundred years. On p. 124 we read further:—

> "The periodicity of variable stars is, besides, of far too disturbed a kind to be thus accounted for. Systematic stability would assuredly prove incompatible with the enormous irregularities it discloses. The abrupt acceleration or retardation, for example, by a month of the hypothetical attendant swarm of Mira, would be impossible without such a total change in the elements of its circulation as would unmistakably break the continuity of its returns. But there are other objects far more recalcitrant than Mira to this mode of explanation. Take the outbursts of U Geminorum. They are not wholly capricious. There is a certain disorderly order about them by which they are manifestly akin to the changes of the more strictly periodical stars. We cannot relegate them to a class apart and invent a fresh hypothesis to suit them; the collision theory, to be acceptable in the one case, must be capable of meeting the other. But we can scarcely conceive any construction of assumptions by which such an extension of its powers could be effected."

Irregularities such as are here referred to are almost bound to occur if the collision theory be true. A star is not limited to one short-period comet any more than is our sun. There may very well be swarms of various masses travelling round the star in regular orbits, and occasionally a swarm travelling in an open orbit may enter the system. These swarms would so react upon each other and upon the central swarm that irregularities would be the inevitable result. Again, the central swarm might vary locally, like the Andromeda nebula, so that the revolving swarm would not always encounter it under exactly the same conditions. That the intervals between successive maxima and the magnitudes at maxima are not constant does not prove that the actions are not periodic.

In NATURE, vol. xlii. p. 550, there are some interesting examples of the apparently irregular results which might be produced by the integration of two sources of regular light variation. Two or more swarms of regular periods with the occasional advent of one moving in a parabolic or hyperbolic orbit, can be made to explain all the facts relating to this class of variables. In the variables of the fourth type, the same explanation holds good, if we consider the direct luminosity of the cometary swarms to be added to that of a dim condensed central body. Miss Clerke, however, supposes that variability depends upon extensive atmospheres, these being disturbed periodically in some way or other, probably by the tidal action of a satellite, so as to produce the observed fluctuations of light. It is a question whether such an atmospheric disturbance could increase the apparent brightness of a star hundreds of times.

The succeeding eight chapters are mainly descriptive, dealing with colour phenomena, double stars, stellar orbits, star clusters, and the forms of nebulæ. It is only necessary to say of these that they are admirable.

Chapter xix., "The Nature and Changes of Nebulæ," discusses the relations of nebulæ and comets, and nebular variability. Referring to comets and nebulæ, it is stated (p. 286) that "traces of a spectroscopic analogy can indeed be shown to exist; but they are met with only in the secondary elements of each spectrum. The resemblance seems only incidental; the dissimilarity essential." It has, however, previously been pointed out (p. 76) that two faint comets observed by Dr. Huggins in 1866–67, gave spectra identical with that of a faint planetary nebula. This may well be regarded as conclusive spectroscopic evidence of the similarity between comets and nebulæ, but although it is apparently only regarded as of secondary importance, "it does not detract from the closeness of a physical analogy." It seems unphilosophical to rely on telescopic similarity when such conclusive spectroscopic evidence is at hand. We might go further than Miss Clerke, and say that as a comet is usually regarded as a swarm of meteorites the same view must be accepted for nebulæ. The information relating to the views on the temperature of nebulæ is very meagre. Some argue that they are intensely hot, whilst others argue that they are cool bodies not unlike comets. Apparently the only statement on this important subject is that on p. 77, where it is stated they "are not greatly heated." Indeed, the evidence afforded by their cometary relationships and by Nova Cygni is conclusive. Yet, as late as 1889, Dr. Huggins stated his belief that the temperature of nebulæ is very high.

It will thus be seen that, although a good deal of Mr. Lockyer's recent important work is left out of consideration, two of his main propositions are accepted by Miss Clerke; viz. (1) "nebulæ merge into unmistakable suns," and (2) they "are not greatly heated."

The remaining chapters consider the distances of the stars, the motion of the solar system, proper motions, the Milky Way, the "status of the nebulæ," and finally the "construction of the heavens." The two latter really discuss the distribution of stars and nebulæ, and bring together a wonderful amount of information which has hitherto been much dispersed.

In justice to Miss Clerke, it is only fair to add that she has exercised a sound judgment on many problems, and has made many valuable suggestions as to the lines on which future investigations should be proceeded with.

The book is well illustrated throughout, among the illustrations being reproductions of some of Mr. Roberts's marvellous photographs. With the exception of that of the Andromeda nebula, these are highly satisfactory.

In conclusion, we would again express our unqualified admiration of a good deal that the book contains, but we cannot help feeling that its value as a contribution to astronomical literature would have been greater if the author had confined herself to simply giving a trustworthy account of contemporary astronomical researches, and of the views held by competent thinkers. A safe and impartial guide to current thought is still a desideratum.

F.

ACROSS GREENLAND.

The First Crossing of Greenland. By Fridtjof Nansen. Translated from the Norwegian by Hubert M. Gepp. With Maps and numerous Illustrations. Two Vols. (London: Longmans, Green, and Co., 1890.)

THE only serious fault to be found with this book is that it is much too long. Only a small proportion of it is devoted to the actual crossing of Greenland, the rest being occupied with matters which might have been, and ought to have been, dealt with concisely. So far as it relates directly to the author's experience, the work is one of the deepest interest. Dr. Nansen is not only an explorer of remarkable courage, resource, and foresight; he has also many of the qualities of a man of letters. He knows exactly on what parts of his story emphasis should be laid, and his skill as a writer is so great that even incidents which do not in themselves seem to be either very striking or very suggestive are made to add to the freshness and vividness of his tale. One of the chief elements of attraction in the book is the more or less unconscious revelation which the author gives of his own character. He has evidently an intense delight in adventure for its own sake, and he writes in such good spirits, with so unaffected a delight in the remembrance of all the difficulties he has overcome, that it is impossible not to follow his record with sympathy and admiration; and every reader will lay down the work with a feeling of sincere regard for a traveller who is at once so hardy, enterprising, and enthusiastic. He has been most fortunate in his translator, who has done his work so well that the narrative reads almost as if it had been originally written in English. The maps and illustrations, too, are unusually good.

In the summer of 1882, when still a very young man, Dr. Nansen spent some months in the northern seas on board the *Viking*, a Norwegian sealer. The ship was caught in the ice off the eastern coast of Greenland, and it was at this time that he first felt a strong desire to investigate the strange, desolate region at which, many times a day, he gazed from the maintop. In the following year the wish was renewed and strengthened when he read of Baron Nordenskiöld's return from the interior of Greenland; but many things came in the way to prevent the fulfilment of his scheme. In 1887 he attempted, through the Norwegian University, to obtain from the Government the means of organizing an expedition; but the Government declined to support the proposal, and one of the newspapers expressed the opinion that "there could be no conceivable reason why the Norwegian people should pay so large a sum as 5000 kr. in order to give a private individual a holiday trip." Herr Augustin Gamél, however, who was already known as an enlightened and generous promoter of Arctic research, offered to provide the necessary funds; and thus Dr. Nansen was enabled at once to make preparations for his contemplated journey. Three of his countrymen—Otto Sverdrup, Oluf Christian Dietrichsen, and Kristian Kristiansen Trana, all of whom were admirably fitted for the work—undertook to accompany him; and he also secured the services of two Lapps—Samuel Johannsen Balto and Ole Nielsen Ravna. The Lapps were of less use than might have been expected; and under a less genial leader they might have become extremely troublesome. Dr. Nansen knew how to appeal to them, and nothing in its way could be better than his description of the devices by which he contrived to inspire them with a little of his own energetic spirit. It may be noted to his credit that he has nothing to say of any of his companions that may not be read with pleasure. He acknowledges frankly and gratefully all that he owed to them in carrying out his bold and hazardous project.

On May 2 the party left Christiania for Leith, whence they started for Iceland; and about a month afterwards they joined the sealer *Jason* at Isafjord, with the owners of which he had come to an agreement that the captain should do his best to put them ashore on the east coast of Greenland. Dr. Nansen has much to say about the voyage to Iceland, about cruising in the ice, about the bladder-nose seal and its capture, and about life on the *Jason*; and some of the facts he records are not without interest. But they are out of place in a work of this kind, which stands in no need of "padding." Even the account of "Ski" and "Skilöbning," by which the chapters on these subjects are preceded, might with advantage have been shortened. Here, however, the author has some excuse for the minuteness of his descriptions, for without "ski" the journey could scarcely have been undertaken, and the subject is one of which he is able to write picturesquely and effectively.

They quitted the *Jason* on July 17, hoping that they might effect a landing without much delay. But for many days they drifted southwards, and sometimes, battling for life among the floes, they could not but feel that success was almost impossible. Dr. Nansen never lost heart, and no part of his story is more stirring than that in which he records the unexpected and perilous adventures encountered at this early stage of his journey. When at last they reached land, they were, he says, "just like children." "A bit of moss, a stalk of grass, to say nothing of a flower, drew out a whole rush of feelings. All was so fresh to us, and the transition was so sudden and complete. The Lapps ran straight up the mountain-side, and for a long while we saw nothing more of them." Dr. Nansen was so relieved and delighted that, when gnats settled on his hand, he "let them sit quietly biting, and took pleasure in their attack." On the same day they embarked again, and pushed on quickly, as it was necessary for them to start from a more northerly position. They landed at their last camping-place on the eastern coast on August 10, and on August 15, after various preliminary arrangements, they set off for the interior, intending that their goal should be Christianshaab. Afterwards Dr. Nansen found it expedient to alter the route, and to make for Godthaab.

Of the journey itself little need be said, as the main facts are already well known, and an adequate conception of the details can be obtained only from the author's fascinating narrative. For some time they had to mount steadily, until they reached a height of 8970 feet. Then they came to a comparatively flat region, beyond which the ice-sheet descended gradually towards the western coast. The difficulties were enormous, for they had to drag their provisions on sledges, and they were repeatedly caught in violent storms, during which they were obliged to remain for shelter in their small tent. The cold was sometimes terrible; their rations were anything but abundant; and they had to sleep in bags. But no obstacles were formidable enough to daunt the leader of the party, and his task was lightened by the fact that he succeeded in maintaining from first to last the most friendly relations with his comrades. Although few incidents of any importance broke the monotony of their progress, Dr. Nansen found much to interest him in such scientific observations as the conditions rendered possible; and even in the interior of Greenland elements of splendour and beauty were not wanting. The greater part of their travelling was done in the daytime, but at first they thought it best to proceed by night. Here are some of Dr. Nansen's reminiscences of his impressions during their night-marches:—

"But if we often suffered a good deal in the way of work, we had full compensation during these nights in the wonderful features of the sky, for even this tract of the earth has its own beauty. When the ever-changing northern lights filled the heavens to the south with their fairy-like display—a display, perhaps, more brilliant in these regions than elsewhere—our toils and pains were, I think, for the most part, forgotten. Or when the moon rose and set off upon her silent journey through the fields of stars, her rays glittering on the crest of every ridge of ice, and bathing the whole of the dead frozen desert in a flood of silver light, the spirit of peace reigned supreme, and life itself became beauty. I am convinced that these night-marches of ours over the 'inland ice' left a deep and ineffaceable impression upon the minds of all who took part in them."

As they advanced over the ice-sheet, they longed more and more for land; and one afternoon, just two months after they had left the *Jason*, they were enchanted by the sudden appearance of a snow-bunting, from which they knew that the western coast could not be very far off. On September 19, Balto caught sight of a black spot in the distance, and immediately afterwards all of them were able to make out, through the mist of snow, "a long, dark mountain ridge, and to the south of it a smaller peak." On September 24, Dr. Nansen found himself "on the brow of an ice-slope which overlooked a beautiful mountain tarn, the surface of which was covered with a sheet of ice"; and shortly afterwards they had the pleasure of walking on solid ground. He says:—

"Words cannot describe what it was for us only to have the earth and stones again beneath our feet, or the thrill that went through us as we felt the elastic heather on which we trod, and smelt the fragrant scent of grass and moss. Behind us lay the 'inland ice,' its cold, grey slope sinking slowly towards the lake; before us lay the genial land. Away down the valley we could see headland beyond headland, covering and overlapping each other as far as the eye could reach."

On October 3, Dr. Nansen and Sverdrup reached Godthaab, where they were soon joined by their companions. For a moment it was unpleasant for them to find that they would have to spend the winter at this remote station; but they met with so much kindness that their stay proved to be in every way more agreeable than they anticipated.

Of the scientific results of the expedition, the most important is the establishment of the fact that the ice-sheet stretches in unbroken continuity over that part of Greenland which the party traversed. How far the ice-sheet extends towards the north we do not yet know; but Dr. Nansen concludes that "its limit must lie beyond the 75th parallel, for so far along the west coast it sends huge glacier-arms into the sea. Among these is Upernivik Glacier, in lat. 73° N., which has a rate of advance of no less than 99 feet in the twenty-four hours. So rapid a movement must presuppose the existence of an enormous interior ice-sheet, which can supply material for consumption on this huge scale." An idea of the form and elevation of the ice-sheet is conveyed by a section or profile drawing, constructed by Prof. Mohn and Dr. Nansen from numerous astronomical and barometrical observations, supplemented by the notes of Dr. Nansen's diary. This section shows that "the ice-sheet rises comparatively abruptly from the sea on both sides, but more especially on the east coast, while its central portion is tolerably flat. On the whole, the gradient decreases the further one gets into the interior, and the mass thus presents the form of a shield with a surface corrugated by gentle, almost imperceptible, undulations lying more or less north and south, and with its highest point not placed symmetrically, but very decidedly nearer the east coast than the west." Dr. Nansen indulges in some speculations as to the action of "great ice-sheets," but here his work is less satisfactory than in those passages in which he simply sets down what he himself has seen. Speaking of the fact that glaciers are stated by geologists to "have carried huge moraines of boulders and grit upon their backs," he says that to his mind "this idea is nothing less than absurd"; which is surely an odd way of talking about a conclusion based on a wide range of careful and exact observations. Dr. Nansen serves science more effectually in presenting facts as to temperature, snow- and rain-fall, and atmospheric pressure, and in describing the daily life of the Eskimo, some of whom he met on the eastern as well as on the western coast.

Dr. Nansen is now making preparations for a Polar expedition, which he proposes to undertake in 1892. If we may judge from his achievements in Greenland, he possesses in no common degree the special talents which are necessary for any measure of success in this larger and more difficult enterprise. No one who reads his book will hesitate to acknowledge that he has shown himself one of the ablest and most daring explorers of the present generation.

OUR BOOK SHELF.

Les Microbes de la Bouche. Par le Dr. Th. David. (Paris: Felix Alcan, 1890.)

THIS book will be found of considerable value. Although Dr. David does not record original observations of his own, most facts stated being copied from other works, he nevertheless deserves credit for putting together in concise form all that is known of the micro-organisms occurring in the oral cavity, on and in the organs of the mouth in health and disease. The morphology, cultural and physiological characters of most of these microbes are described in detail, including those of diphtheria, tubercle, and actinomycosis. From p. 205 to p. 262 the author gives a valuable account of the bacteria present in diseased teeth, but unfortunately he adds—probably for purposes of the professional dentist—a number of prescriptions on cosmetics, tooth powders, &c., which ought not to find a place in a scientific work of the character of the present book. The appendix on influenza might well have been omitted.

Notes on the Products of Western Afghanistan and North-Eastern Persia. By J. E. T. Aitchison, C.I.E., M.D., F.R.S. Pp. 228. (Edinburgh: Neill and Co., 1890.)

A REPRINT from the Transactions of the Botanical Society of Edinburgh, containing an alphabetical synopsis of the animal, vegetable, and mineral products of Western Afghanistan and Eastern Persia, together with their native names, with their English and Latin equivalents, and their applications. Dr. Aitchison's contributions to the botany and zoology of Afghanistan and